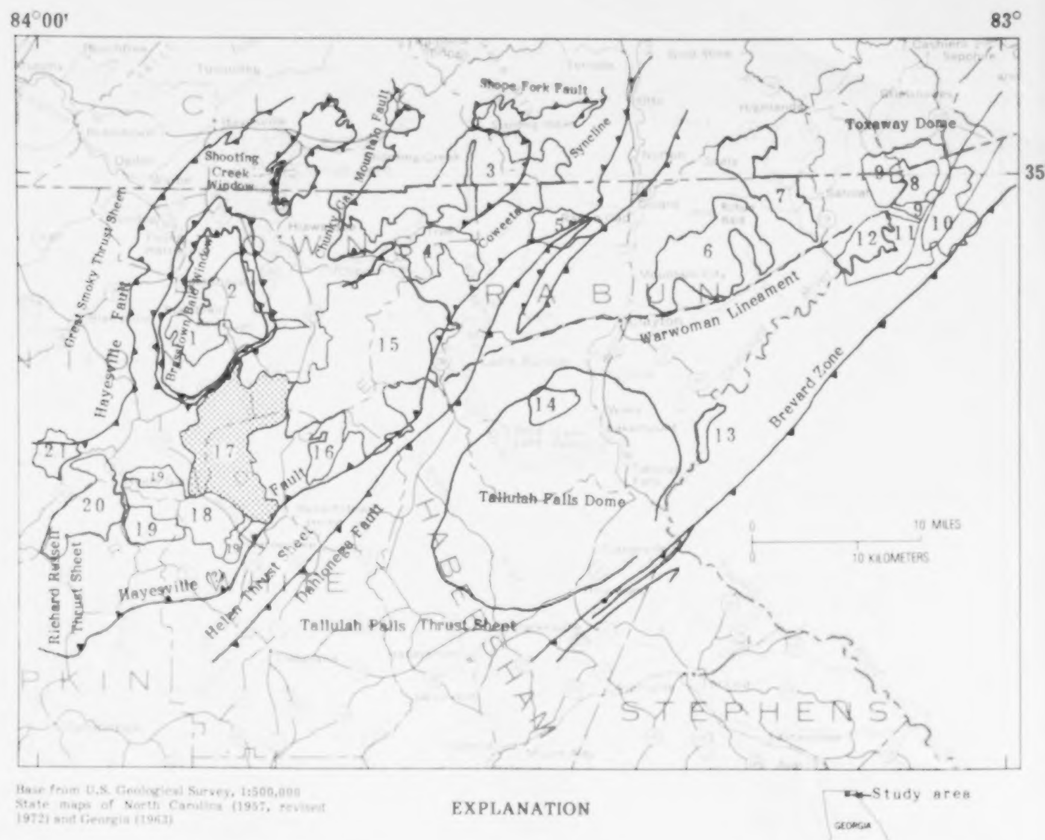
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



Base from U.S. Geological Survey, 1:500,000 State maps of North Carolina (1957, revised 1972) and Georgia (1963)

EXPLANATION

Wilderness Areas

3 Southern Nantahala Wilderness
8 Ellicott Rock Wilderness

Roadless Areas

1 Wolf Pen (08-149)	13 Long Creek (08-113)
2 Brasstown (08-146)	14 Worley Ridge (08-224)
4 Buzzard Knob (08-223)	15 Tray Mountain (08-)
5 Southern Nantahala (B8025)	16 Anna Ruby (08-225)
6 Rabun Bald (08-147)	17 Chattahoochee (08-029)
7 Overflow (08-026)	18 Raven Cliff (A8028)
9 Ellicott Rock Extension (A8031)	19 Raven Cliff (B8028)
10 Persimmon Mountain (L8116)	20 Blood Mountain (08-027)
11 Ellicott Rock Expansion (08-112)	21 Board Camp (08-145)
12 Rand Mountain (08-148)	

Figure 1.--Index map showing locations of wilderness and roadless areas and major structural features in northeastern Georgia and adjacent North and South Carolina. The Chattahoochee area is shown by a pattern. Number after roadless name is U.S. Forest Service identification number. Geology modified from Hatcher and Butler (1979) and Nelson and others (1987).

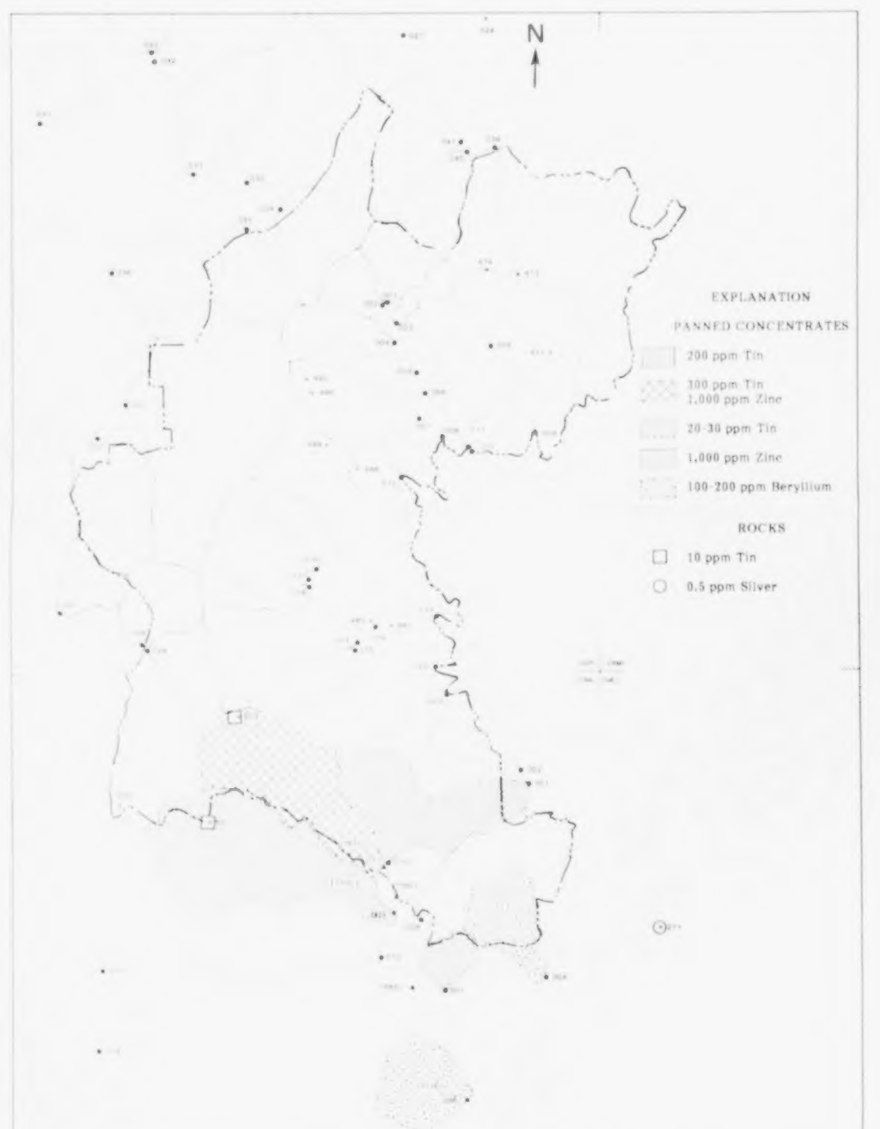
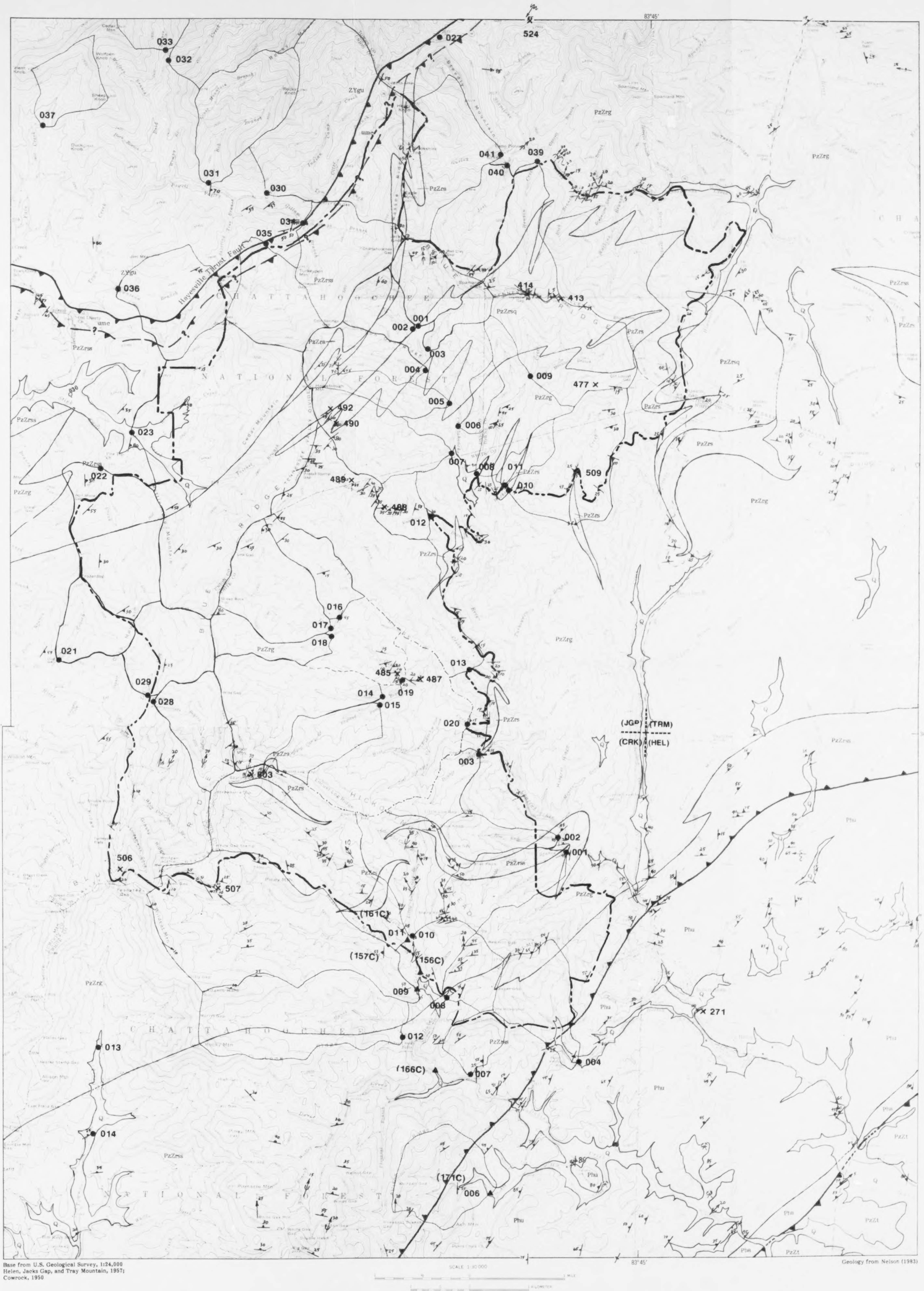


Figure 3.--Map of stream drainage basins with high concentrations of tin, zinc, and beryllium in nonmagnetic fractions of refined panned-concentrate samples of alluvial gravels, and of rocks with anomalous tin or silver. See figure 2 for explanation of other symbols used.



Base from U.S. Geological Survey, 1:24,000
Helen, Jacks Gap, and Tray Mountain, 1957;
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Geology from Nelson (1983)

SCALE 1:30 000

CONTOUR INTERVAL 40 FEET

Figure 2.--Sample location map showing drainage basin outlines for stream-sediment and panned-concentrate samples, and major geologic units

EXPLANATION
(For detailed descriptions of geologic map units, see Nelson, 1983)

Q	**Quaternary deposits**--Unconsolidated colluvium and alluvium. Coarse bouldery and cobbly gravels, sand, and clay
	Unnamed lower Paleozoic and (or) Late Proterozoic assemblage informally called the "Richard Russell group"
PzZrg	Biotite gneiss, metasandstone, biotite schist, muscovite-biotite schist, hornblende gneiss and amphibolite, calc-silicate layers, minor gabbroic granite, granite gneiss
PzZrss	Metasandstone, biotite gneiss, biotite schist, muscovite-biotite schist, hornblende gneiss, amphibolite
PzZrsq	Feldspathic quartz-rich metasandstone
PzZrs	Biotite schist, muscovite-biotite schist, metasandstone, biotite gneiss, granite gneiss
PzZra	Amphibolite
PzZt	Tallulah Falls Formation--Alternating sequence of migmatitic impure metasandstone and graywacke, biotite gneiss, biotite schist, and amphibolite
ZYgu	Undivided Late Proterozoic rocks of Great Smoky thrust sheet exposed in window through Hayesville thrust sheet--Metasandstone and mica schist
Phu	Helen belt rocks (Proterozoic)--Metasandstone and mica schist
ume	Ultramafic-mafic complex (age uncertain)
— — —	Approximate boundary of roadless area
——— - - -	Contact--Approximately located. Dashed where concealed
▲? ▲ -	Thrust fault--Approximately located. Sawteeth on upper plate. Dashed where concealed; queried where probable
	Strike and dip of layering and foliation
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	Vertical
	Horizontal
	Strike and dip of cleavage
→	Bearing and plunge of lineation
	Minor synform showing plunge of axis
	Minor antiform showing plunge of axis
	Minor fold showing plunge of axis
⚒	Abandoned quarry
	Abandoned sand and gravel pit
×	Prospect
	Mine
	Abandoned mine
● 004	Outline of drainage basin--Dashed lines indicate greater order drainage basins. Dot indicates U.S. Geological Survey stream-sediment sample location. Triangle and numbers in parentheses indicate resampled basins (see text). Stream-sediment sample number should be prefixed with CRK for samples collected in the Cowrock quadrangle part of the study area, HEL for those in the Helena quadrangle, JGP for those in the Jacks Gap quadrangle, and TRM for those in the Tray Mountain quadrangle. See dashed lines on map indicating quadrangle boundaries.
×467	Rock sample locality

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) to survey certain areas of Federal Lands to determine what mineral resource potential, if any, might be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Chattahoochee Roadless Area. (U.S. Forest Service no. 08-029) in the Chattahoochee National Forest, Union, Towns, and White Counties, Georgia. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979).

INTRODUCTION

The U.S. Geological Survey made a reconnaisance geochemical survey of Chattahoochee Roadless Area (fig. 1) to search for unexposed mineral deposits which might be recognized by a geochemical signature in the abundance or distribution patterns of trace elements. As part of a regional geochemical reconnaissance, M. Hurst (University of Georgia) collected 51 fine-grained stream-sediment samples and 45 panned-concentrate samples of alluvial gravels in the Chattahoochee study area (see figure 1). A.E. Nelson, in conjunction with detailed geologic mapping (Nelson, 1983), collected 10 rock-chip samples for geochemical analysis in addition to a large number of hand specimens for thin section study. In order to evaluate isolated anomalies indicated by the earlier sampling, R.P. Koeppen, D.M. Sutphin, and P.D. Schruben collected several additional panned-concentrate, stream sediment, and rock samples from the area in 1986. Both the geologic study by Nelson (1983) and this geochemical survey provide the basis for our mineral-resource assessment of the Chattahoochee Roadless Area (Nelson and others, 1983).

PROCEDURES

Most of the small drainage basins within and immediately adjacent to the study area were sampled by collecting a few handfuls of the finest sediment available and (or) by pan concentrating the heavy minerals in alluvial gravels from the active stream channels. Rock-chip samples representative of the major lithologic units in the area also were collected for geochemical study.

Fine-grained stream sediments were dried and sieved to minus 80-mesh (0.006 in.), then pulverized to minus 140 mesh (0.004 in.). Panned-concentrate samples were washed in bromoform to remove light minerals, then passed by a hand magnet to remove most magnetite. The remaining mineral was then split into magnetic and nonmagnetic fractions on a Frantz isodynamic separator, some at a setting of 1.0 amp, and some at settings of 0.5 and 1.0 amp. The two fractions were crushed and pulverized to minus 140-mesh and analyzed. Rock chips were similarly pulverized.

Each sample was analyzed semiquantitatively for 31 elements by a six-step, direct-current arc, optical-emission spectrographic method (Grimes and Marranzino, 1968) by D.F. Siems at the U.S. Geological Survey laboratories in Denver, Colo. Semiquantitative spectrographic analytical values are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so forth. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within two adjoining intervals 96 percent of the time (Motooka and Grimes, 1976). The complete data are reported in Siems and others (1988). Locations of samples and associated drainage basins are shown in figure 2. A statistical study is given in table 1. Partial geochemical data for selected samples discussed in the text is given in table 2.

DISCUSSION

Our reconnaissance geochemical survey of the Chattahoochee Roadless Area found trace-metal enrichment in panned concentrates and one rock sample. In this survey, no metallic mineral deposits were found. However, slightly enriched trace-metal levels were identified in a number of samples. Geochemical data for six elements (iron, manganese, silver, tin, zinc, and beryllium) show a few high concentrations in either stream-sediment or rock samples. Although the study area is located immediately adjacent to the Dahlonega gold belt, none of our geochemical samples contained detectable amounts of gold. The few anomalous metal concentrations found do not indicate the presence of mineral deposits. The sources of local concentrations of trace elements is not known. The geochemical data for the trace-element-enriched samples are discussed individually in the following section.

Geologic Setting

Metamorphic rocks of three major lithotectonic units form part of Blue Ridge Mountains in the southern Appalachians. They are the Great Smoky thrust sheet, the Richard Russell thrust sheet, and the Helen thrust sheet (Nelson, 1983; Nelson and Gillon, 1985; Nelson and others, 1987). Almost all of the exposed rocks in the Chattahoochee Roadless Area are part of the Richard Russell thrust sheet with the exception of a relatively narrow band of mafic and ultramafic rocks that occurs along the northwest boundary of the study area. The Richard Russell thrust sheet in the study area is underlain immediately to the northwest by rocks of the Great Smoky thrust sheet and on the southeast by rocks of the Helen thrust sheet. The Richard Russell and Great Smoky thrust sheets are separated by the southeast-dipping Hayesville fault (Hatcher and Williams, 1978; Nelson and Gillon, 1985).

Richard Russell thrust sheet.--Most of the Chattahoochee Roadless Area is underlain by rocks of the Richard Russell Formation (Nelson and Gillon, 1985, p. A61). This rock assemblage includes polydeformed, highly migmatitic biotite gneiss, biotite schist, fine-grained biotite-feldspar gneiss, metasandstone, amphibolite, hornblende gneiss, granite gneiss, discontinuous pegmatite veins and pods of varying size, and many irregular granitic masses. Sillimanite, though widely distributed, generally occurs in rocks with a low muscovite content.

Helen thrust sheet.--Although rocks of the Helen thrust sheet do not occur at the surface within the Chattahoochee Roadless Area, they are exposed less than 330 ft from the southeast border of the study area. Rocks in the thrust sheet include metagraywacke, quartzite, graphite-bearing garnet-muscovite-biotite schist, biotite-feldspar metasandstone, and pegmatite veins and pods. The metasandstone is locally conglomeratic and interlayered with thin beds of muscovite schist. Thin to thick layers of amphibolite also are present.

Table 1.--*Statistical summary of geochemical data for the Chattahoochee Roadless Area, from data in Siems and others (1988). Data from other wilderness areas shown for comparison*

All analyses in U.S. Geological Survey laboratories, Denver, Colo., by D.F. Siems using semiquantitative spectrographic methods, except for zinc in panned concentrate M1 (1.0 amp magnetic) fraction which was determined by atomic absorption methods by D.F. Siems. Spectrographic analyses are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate medians of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. The precision is expected to be within one adjoining reporting interval on each side of the reported value 83 percent of the time; M1, 1.0 amp magnetic fraction. Symbols used: >, amount is greater than number shown; <, amount is less than number shown; --, not detected.

	STREAM SEDIMENTS										PANNED CONCENTRATES								ROCKS (GNEISS)									
	CHATTAHOOCHEE			AR[1]	BM[7]	SN[8]	CM[2]	ER[3]	SR[5]	TM[4]	CHATTAHOOCHEE			SN[8]	AR[1]	CM[2]	ER[3]	TM[4]	CHATTAHOOCHEE			BM[7]	CM[2]	SN[8]	ER[3]	SR[5]	Average[6,9] sandstone
	n=51			n=19	n=57	n=171	n=30	n=103	n=94	n=87	n=41			n=139	n=12	n=10	n=76	n=78	n=10			n=15	n=16	n=148	n=10	n=37	
Element	Low	High	Median	Median	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	
	PERCENT																										
Calcium	0.05	0.5	0.15	0.3	0.3	0.5	0.6	0.3	1	0.3	0.1	1.5	0.15	0.2	0.3	0.07	0.5	0.2	0.15	2	0.3	1	0.7	0.5	1	1	3.9
Iron	2	7	3.	2	2	5	5	2	7	2.5	.1	20	.7	.7	.5	2	15	.3	1	7	5	10	2.5	3	5	5	.98
Magnesium	.1	1.5	.5	.5	1	.7	.5	.3	1	.3	.05	2	.1	.07	.2	.5	.15	.1	.3	1.5	1	1	.7	1	1	1	.7
Titanium	.2	1	.5	.5	1	1	.7	.3	.5	.4	.7	2	1.5	2	1.4	>1	>1	1.2	.03	2.0	.3	.5	.5	.5	.5	.5	.15
	PARTS PER MILLION (ppm)																										
Barium	150	2,000	700	500	1,000	300	500	500	700	330	<50	300	70	50	300	125	100	90	500	1,500	1,000	700	500	500	700	1,000	300
Beryllium	<1	2	1	2	1.5	1	1.5	<1	1.5	1	<2	200	<2	<2	<2	<1	<1	--	1	7	2	2	1	1	1	1	2
Boron	<10	200	10	<10	<10	<10	10	10	15	10	<20	150	<5	20	20	20	20	--	<10	10	<10	<10	<10	10	<10	10	35
Chromium	20	70	50	70	100	70	50	20	100	50	<20	300	70	100	50	200	100	80	10	1,500	100	100	30	30	60	50	35
Cobalt	7	30	15	10	20	10	20	7	15	15	<10	20	<10	<10	<10	7	15	20	<5	15	10	10	10	10	7	10	.3
Copper	<5	50	20	20	50	15	20	7	20	20	--	--	--	<10	<10	7	<5	20	7	100	30	30	10	10	10	15	10-20
Lanthanum	20	500	150	100	300	50	150	30	100	50	<50	2,000	50	100	200	400	500	130	<20	200	150	50	30	50	50	50	7
Lead	<10	70	20	30	20	15	30	20	50	15	<20	150	20	<20	<20	<10	<10	45	20	70	30	20	13	15	40	20	7
Manganese	200	1,000	500	700	700	1,000	2,000	300	1,500	550	<50	10,000	150	100	100	300	5,000	80	30	700	500	500	700	700	500	700	500
Molybdenum	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	--	--	<10	<10	<10	<10	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	.2
Nickel	5	30	20	15	15	20	20	10	20	30	<10	50	10	<10	<10	10	<5	30	7	30	10	30	15	15	10	20	2
Niobium	<20	30	<20	<20	15	<20	<20	<20	<20	20	<50	700	100	<50	<50	25	50	70	<20	--	<20	<20	<20	<20	<20	<20	.0X[10]
Scandium	5	20	15	7	20	7	15	7	15	10	<20	200	70	<10	<10	5	30	30	<5	20	15	15	10	10	10	10	1
Strontium	<100	150	<100	<100	<100	100	200	<100	150	100	<200	300	<200	<200	200	<200	<100	--	<100	300	200	100	180	200	150	200	20
Thorium	<100	--	<100	<100	--	<100	--	<100	<100	--	--	--	<200	<200	<200	--	<100	--	<10	--	<10	<10	<10	<10	<10	<10	.X[10]
Tin	<10	--	<10	<10	<10	<10	<10	<10	<10	<10	<20	300	<20	<20	<20	<20	<10	--	<100	--	<100	<100	--	--	<100	<100	5.5
Vanadium	30	150	100	50	100	100	100	50	100	70	50	500	200	70	100	200	150	90	10	150	100	100	70	<100	85	100	20
Yttrium	15	150	70	70	100	50	70	30	50	30	70	2,000	700	100	500	50	700	600	<10	70	50	70	30	50	20	30	10
Zinc	<200	--	<200	<200	<200	<200	<200	<200	<200	260	<500	1,000	<500	<500	<500	<200	<200	650	<200	200	<200	<200	<200	30	<200	<200	16
Zirconium	100	>1,000	700	700	1,000	500	300	500	300	400	2,000	<2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000	<10	500	100	700	200	200	300	200	220

Table 2.--*Partial analyses from the Chattahoochee Roadless Area. Tin, zinc, beryllium, and silver are spectrophotometrically determined. Analysis by D.E. Detra.*

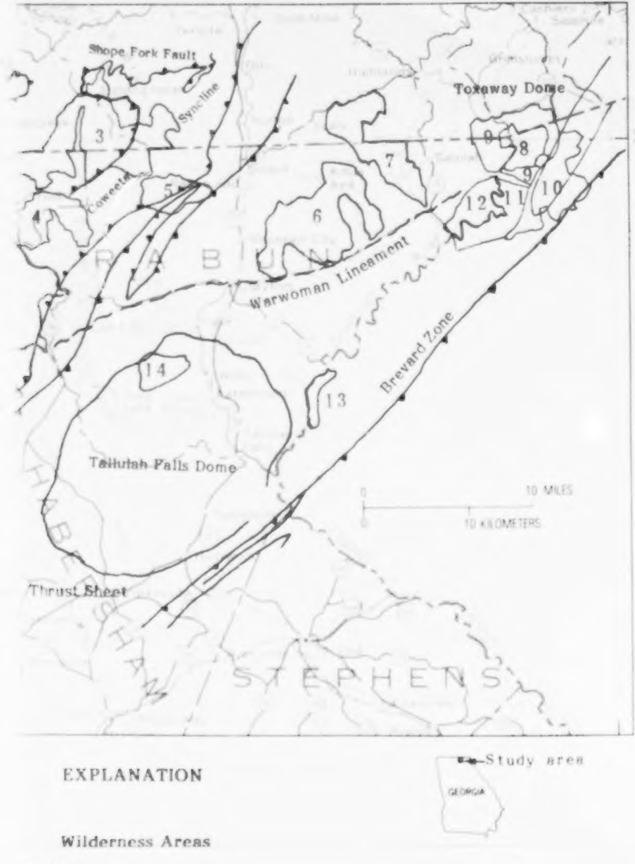
SAMPLE NO.	TIN	ZINC	BERYLLLIUM	SILVER
		PANNED CONCENTRATES		
GCO2156C	70	500	L(2)	N(1)
GCO2157C	700	N(500)	L(2)	N(1)
GCO2161C	70	700	L(2)	N(1)
GCO2166C	100	L(500)	L(2)	N(1)
GCO2171C	0	L(500)	10	N(1)
CRK004C	0	N(200)	100	N(.5)
CRK006C	0	N(200)	200	N(.5)
CRK009C	200	1,000	3	N(.5)
CRK011C	300	0	3	N(.5)
		ROCKS		
N492R	N(10)	200	2	.5
N503R	10	200	1	N(.5)
N271R	N(10)	N(200)	7	.5

GEOCHEMICAL SURVEY OF THE CHATTAHOOCHEE ROADLESS AREA, TOWNS, UNION, AND WHITE COUNT

By
Robert P. Koeppen and Arthur E. Nelson
1989

ERIOR

MISCELLANEOUS FIELD STUDIES
MAP MF—1502-B



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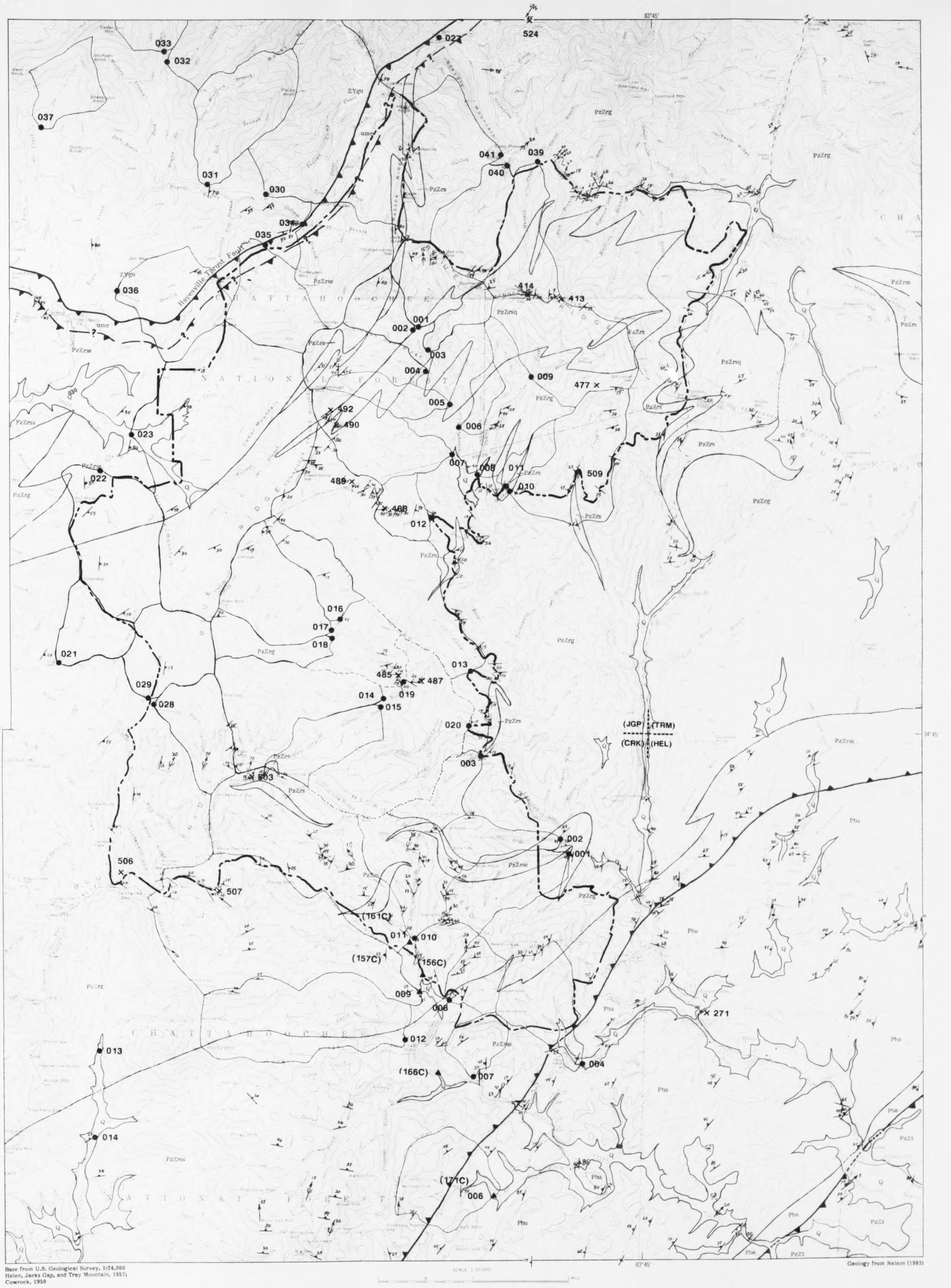

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Each sample was analyzed semiquantitatively for 31 elements by a six-step, direct-current arc, optical emission spectrographic method (Grimes and Marranzino, 1968) by D.F. Siems at the U.S. Geological Survey laboratories in Denver, Colo. Semiquantitative spectrographic analytical values are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so forth. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within two adjoining intervals 96 percent of the time (Motooka and Grimes, 1976). The complete data are reported in Siems and others (1988). Locations of samples and associated drainage basins are shown in figure 2. A statistical study is given in table 1. Partial geochemical data for selected samples discussed in the text is given in table 2.

DISCUSSION

Our reconnaissance geochemical survey of the Chattahoochee Roadless Area found trace-metal enrichment in panned concentrates and one rock sample. In this survey, no metallic mineral deposits were found. However, slightly enriched trace-metal levels were identified in a number of samples. Geochemical data for six elements (iron, manganese, silver, tin, zinc, and beryllium) show a few high concentrations in either stream-sediment or rock samples. Although the study area is located immediately adjacent to the Dahlonega gold belt, none of our geochemical samples contained detectable amounts of gold. The few anomalous metal concentrations found do not indicate the presence of mineral deposits. The sources of local concentrations of trace elements is not known. The geochemical data for the trace-element-enriched samples are discussed individually in the following section.

Geologic Setting

Metamorphic rocks of three major lithotectonic units form part of Blue Ridge Mountains in the southern Appalachians. They are the Great Smoky thrust sheet, the Richard Russell thrust sheet, and the Helen thrust sheet (Nelson, 1983; Nelson and Gillon, 1985; Nelson and others, 1987). Almost all of the exposed rocks in the Chattahoochee Roadless Area are part of the Richard Russell thrust sheet with the exception of a relatively narrow band of mafic and ultramafic rocks that occurs along the northwest boundary of the study area. The Richard Russell thrust sheet in the study area is underlain immediately to the northwest by rocks of the Great Smoky thrust sheet and on the southeast by rocks of the Helen thrust sheet. The Richard Russell and Great Smoky thrust sheets are separated by the southeast-dipping Hayesville fault (Hatcher and Williams, 1978; Nelson and Gillon, 1985).

Richard Russell thrust sheet.--Most of the Chattahoochee Roadless Area is underlain by rocks of the Richard Russell Formation (Nelson and Gillon, 1985, p. A61). This rock assemblage includes polydeformed, highly migmatitic biotite gneiss, biotite schist, fine-grained biotite-feldspar gneiss, metasandstone, amphibolite, hornblende gneiss, granite gneiss, discontinuous pegmatite veins and pods of varying size, and many irregular granitic masses. Sillimanite, though widely distributed, generally occurs in rocks with a low muscovite content.

Helen thrust sheet.--Although rocks of the Helen thrust sheet do not occur at the surface within the Chattahoochee Roadless Area, they are exposed less than 330 ft from the southeast border of the study area. Rocks in the thrust sheet include metagraywacke, quartzite, graphite-bearing garnet-muscovite-biotite schist, biotite-feldspar metasandstone, and pegmatite veins and pods. The metasandstone is locally conglomeratic and interlayered with thin beds of muscovite schist. Thin to thick layers of amphibolite also are present.

Ultramafic-mafic rocks.--A wide variety of ultramafic-mafic rocks are present in the southern Blue Ridge Mountains as larger mappable units and as small discontinuous pods (Hadley and Nelson, 1971). The mafic-ultramafic rocks that are present near the northwest border of the study area along the northeast-trending Hayesville fault (Nelson, 1983) are now recognized as part of the Young Harris thrust slice. This slice separates the Richard Russell thrust sheet from underlying rocks of the Great Smoky Group (Nelson and others, 1987). These rocks are chiefly serpentinite, dunite, pyroxenite, gabbro, and amphibolite (Hartley, 1973). Locally, some of the rocks are rich in magnetite, corundum, and rutile. Ultramfic rocks also are exposed along the regional strike to the northeast of the roadless area. They may be locally present below or within the Richard Russell thrust sheet within the study area.

Iron and manganese

A single nonmagnetic fraction of a panned-concentrate sample from a stream in the central part of the area contained 20 percent iron and 10,000 parts per million (ppm) manganese, concentrations which are anomalous for both these metals. Analyses of additional samples collected from this locality, however, showed no enrichment for either iron or manganese. None of the rock samples from the area contained an unusually high abundance of these metals. Because we do not know the source of this anomaly, and could not duplicate it in subsequent sampling, we consider that it does not indicate a significant resource of iron or manganese.

Silver

Silver was detected spectrographically in two rock samples: a metasandstone from Horsetrough Mountain near the center of the roadless area (sample N492 on figure 3) and a schist from the Helen Group, several miles east of the area (sample N271 on figure 3). The silver-bearing sample from within the study area is anomalous because of the absence of detectable silver in other rock samples from within the area. An isolated occurrence of silver also has been reported in stream sediments along the boundary with the adjacent Tray Mountain Wilderness (Koeppen and Nelson, 1988). Silver was not detected in any other samples from the area. The significance and source of these dispersed silver anomalies is not known or understood, but do no indicate significantly mineralized rock.

Tin and zinc

Tin was detected in both heavy-mineral panned-concentrate and rock samples from the area. Panned concentrate samples (CRK009 and CRK011, table 2 and figure 3) from drainage basins along the southern border of the roadless area contain 300 and 200 ppm of tin, respectively; sample CRK009 also contains 1,000 ppm of zinc. Samples from several other nearby streams contained lower values for tin and higher values for zinc. These were the elements that showed the most well-defined distribution within the roadless area. Some samples also showed slight enrichments of lead (50-150 ppm). Resampling from these streams in 1985 also identified anomalous levels of tin (70-700 ppm) and zinc (500-1,000 ppm) (table 2 and figure 3). The tin occurs in the nonmagnetic fraction of the panned-concentrate samples, thus suggesting that the occurrence is in the form of cassiterite and not as a solid-solution component of magnetite. Only one rock sample (N503), a mica schist, contains detectable amounts of tin (10 ppm). This single tin-bearing rock sample came from the same catchment from which tin-enriched panned-concentrate samples were retrieved. The high tin content identified in the initial sampling was reproduced during resampling. This suggests that the high values probably were not a result of any analytical bias; the tin levels for all other samples from the roadless area were below the limit of determination. The clustering of tin values in the southern part of the roadless area may reflect a possible stratigraphic or structural control. Tin occurs sporadically in stream sediments derived from the Richard Russell Formation rocks (Koeppen and Nelson, 1988; Siems and others, 1988), but a source of these scattered anomalies is not known. Anomalous generally low tin values (15-30 ppm) have been identified elsewhere in the Richard Russell Formation in calc-silicate lenses (Peper and others, in press). Visible evidence of any tin mineralization in the area is not present. Therefore, these anomalous values for tin in the Chattahoochee Roadless Area are unlikely to be indicators of significant economic mineralization.

Beryllium

Panned-concentrate samples from Ash Creek (CRK004) and Horton Creek (CRK006) (fig. 3) at the southeast edge of the roadless area contain 100 and 200 ppm beryllium, respectively. Both streams were resampled, but only the sample from Ash Creek (GCO217C) produced an anomalous beryllium concentration of 10 ppm. Sheared granite and granite pegmatite occur within these stream drainages, but samples of these rocks, and all other rock samples from the study area, contained no significant beryllium (1-3 ppm). The Helen pegmatite district, located approximately 10 km to the northeast, was identified by W.R. Griffitts (1960, written commun.) as a beryllium prospective area, but we have been unable to find reports of either gemstone beryl occurrences or beryl production from this district. The absence of identified beryllium enrichment in other samples from the area indicates that the beryllium in these three panned-concentrate samples is anomalous. Although beryl mineralization is commonly associated with pegmatites, the abundant pegmatite pods and dikes in this area yielded no beryl occurrences. The source of the beryllium is not known. The available data indicate that there is little or no potential for beryllium resources in the Chattahoochee Roadless Area.

CONCLUSIONS

A few heavy-mineral panned-concentrate and several rock samples contained low, though anomalous, concentrations of certain trace metals. Anomalous concentrations of trace metals were identified in panned-concentrate samples from streams clustered near one another near the southwest corner of the area: one contains 300-700 ppm tin, three others contain 70-100 ppm tin, and several contain 500-1,000 ppm zinc. The rock samples yielded anomalous tin and silver. A mica schist sample from the same catchment where an anomalous tin-enriched panned-concentrate sample also was collected contains 10 ppm tin. A metasandstone sample contained a low concentration of silver. Several stream-sediment samples from along or near the southern boundary of the area contain low to moderate levels of beryllium; resampling confirmed the presence of beryllium although at much lower intensity than the original sampling. These anomalous metal concentrations could be related to low-grade mineralizing processes; if so, it seems unlikely that the results of these processes would be deposits of significant size or of economic importance. Further investigation involving a more thorough and detailed geochemical sampling design would be required to corroborate and determine the significance of the anomalous trace-element concentrations reported here. The available geochemical data indicate that these dispersed geochemical anomalies represent only isolated minor mineral occurrences and that there is little, if any, potential for significant metallic mineral resources in the Chattahoochee Roadless Area.

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Table 1.--*Statistical summary of geochemical data for the Chattahoochee Roadless Area, from data in Siems and others (1988). Data from other wilderness areas shown for comparison*

All analyses in U.S. Geological Survey laboratories, Denver, Colo., by D.F. Siems using semiquantitative spectrographic methods, except for zinc in panned concentrate M1 (1.0 amp magnetic) fraction which was determined by atomic absorption methods by D.F. Siems. Spectrographic analyses are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate medians of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. The precision is expected to be within one adjoining reporting interval on each side of the reported value 83 percent of the time; M1, 1.0 amp magnetic fraction. Symbols used: >, amount is greater than number shown; <, amount is less than number shown; --, not detected.

STREAM SEDIMENTS						PANNED CONCENTRATES								ROCKS (GNEISS)								
BM[7]	SN[8]	CM[2]	ER[3]	SR[5]	TM[4]	CHATTAHOOCHEE			SN[8]	AR[1]	CM[2]	ER[3]	TM[4]	CHATTAHOOCHEE			BM[7]	CM[2]	SN[8]	ER[3]	SR[5]	Average[6,9] sandstone
n=57	n=171	n=30	n=103	n=94	n=87	n=41			n=139	n=12	n=10	n=76	n=78	n=10			n=15	n=16	n=148	n=10	n=37	
Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	
PERCENT						PERCENT								PERCENT								
0.3	0.5	0.6	0.3	1	0.3	0.1	1.5	0.15	0.2	0.3	0.07	0.5	0.2	0.15	2	0.3	1	0.7	0.5	1	1	3.9
2	5	5	2	7	2.5	.1	20	.7	.7	.5	2	15	.3	1	7	5	10	2.5	3	5	5	.98
1	.7	.5	.3	1	.3	.05	2	.1	.07	.2	.5	.15	.1	.3	1.5	1	1	.7	1	1	1	.7
1	1	.7	.3	.5	.4	.7	2	1.5	2	1.4	>1	>1	1.2	.03	2.0	.3	.5	.5	.5	.5	.5	.15
PARTS PER MILLION (ppm)						PARTS PER MILLION (ppm)								PARTS PER MILLION (ppm)								
1,000	300	500	500	700	330	<50	300	70	50	300	125	100	90	500	1,500	1,000	700	500	500	700	1,000	300
1.5	1	1.5	<1	1.5	1	<2	200	<2	<2	<2	<1	<1	—	1	7	2	2	1	1	1	1	2
<10	<10	10	10	15	10	<20	150	<5	20	20	20	20	—	<10	10	<10	<10	<10	10	<10	10	35
100	70	50	20	100	50	<20	300	70	100	50	200	100	80	10	1,500	100	100	30	30	60	50	35
20	10	20	7	15	15	<10	20	<10	<10	<10	7	15	20	<5	15	10	10	10	10	7	10	.3
50	15	20	7	20	20	--	--	—	<10	<10	7	<5	20	7	100	30	30	10	10	10	15	10-20
300	50	150	30	100	50	<50	2,000	50	100	200	400	500	130	<20	200	150	50	30	50	50	50	7
20	15	30	20	50	15	<20	150	20	<20	<20	<10	<10	45	20	70	30	20	13	15	40	20	7
700	1,000	2,000	300	1,500	550	<50	10,000	150	100	100	300	5,000	80	30	700	500	500	700	700	500	700	500
<5	<5	<5	<5	<5	<5	--	--	<10	<10	<10	<10	<5	—	<5	<5	<5	<5	<5	<5	<5	<5	.2
15	20	20	10	20	30	<10	50	10	<10	<10	10	<5	30	7	30	10	30	15	15	10	20	2
15	<20	<20	<20	<20	20	<50	700	100	<50	<50	25	50	70	<20	—	<20	<20	<20	<20	<20	<20	.0X[10]
20	7	15	7	15	10	<20	200	70	<10	<10	5	30	30	<5	20	15	15	10	10	10	10	1
<100	100	200	<100	150	100	<200	300	<200	<200	200	<200	<100	—	<100	300	200	100	180	200	150	200	20
--	<100	--	<100	<100	--	--	--	<200	<200	<200	—	<100	—	<10	—	<10	<10	<10	<10	<10	<10	.X[10]
<10	<10	<10	<10	<10	<10	<20	300	<20	<20	<20	<20	<10	—	<100	—	<100	<100	--	--	<100	<100	5.5
100	100	100	50	100	70	50	500	200	70	100	200	150	90	10	150	100	100	70	<100	85	100	20
100	50	70	30	50	30	70	2,000	700	100	500	50	700	600	<10	70	50	70	30	50	20	30	10
<200	<200	<200	<200	<200	260	<500	1,000	<500	<500	<500	<200	<200	650	<200	200	<200	<200	<200	30	<200	<200	16
[illegible]	[illegible]	300	500	300	400	2,000	<2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000	<10	500	100	700	200	200	300	200	220

Table 2.--*Partial analyses from the Chattahoochee Roadless Area. Tin, zinc, beryllium, and silver are spectrophotometrically determined. Analysis by D.E. Detra.*

SAMPLE NO.	TIN	ZINC	BERYLLLIUM	SILVER
PANNED CONCENTRATES				
GCO2156C	70	500	L(2)	N(1)
GCO2157C	700	N(500)	L(2)	N(1)
GCO2161C	70	700	L(2)	N(1)
GCO2166C	100	L(500)	L(2)	N(1)
GCO2171C	0	L(500)	10	N(1)
CRK004C	0	N(200)	100	N(.5)
CRK006C	0	N(200)	200	N(.5)
CRK009C	200	1,000	3	N(.5)
CRK011C	300	0	3	N(.5)
ROCKS				
N492R	N(10)	200	2	.5
N503R	10	200	1	N(.5)
N271R	N(10)	N(200)	7	.5

GEOCHEMICAL SURVEY OF THE CHATTAHOOCHEE ROADLESS AREA, TOWNS, UNION, AND WHITE COUNTIES, GEORGIA

By

Robert P. Koeppen and Arthur E. Nelson

1989

3 Southern Nantahala Wilderness
8 Ellicott Rock Wilderness

Roadless Areas

1 Wolf Pen (08-149)
2 Brasstown (08-146)
4 Buzzard Knob (08-223)
5 Southern Nantahala (B8025)
6 Rabun Bald (08-147)
7 Overflow (08-026)
9 Ellicott Rock Extension (A8031)
10 Persimmon Mountain (L8116)
11 Ellicott Rock Expansion (08-112)
12 Rand Mountain (08-148)
13 Long Creek (08-113)
14 Worley Ridge (08-224)
15 Tray Mountain (08-)
16 Anna Ruby (08-225)
17 Chattahoochee (08-029)
18 Raven Cliff (A8028)
19 Raven Cliff (B8028)
20 Blood Mountain (08-027)
21 Board Camp (08-145)

Figure 1.--Index map showing locations of wilderness and roadless areas and major structural features in northeastern Georgia and adjacent North and South Carolina. The Chattahoochee area is shown by a pattern. Number after roadless name is U.S. Forest Service identification number. Geology modified from Hatcher and Butler (1979) and Nelson and others (1987).

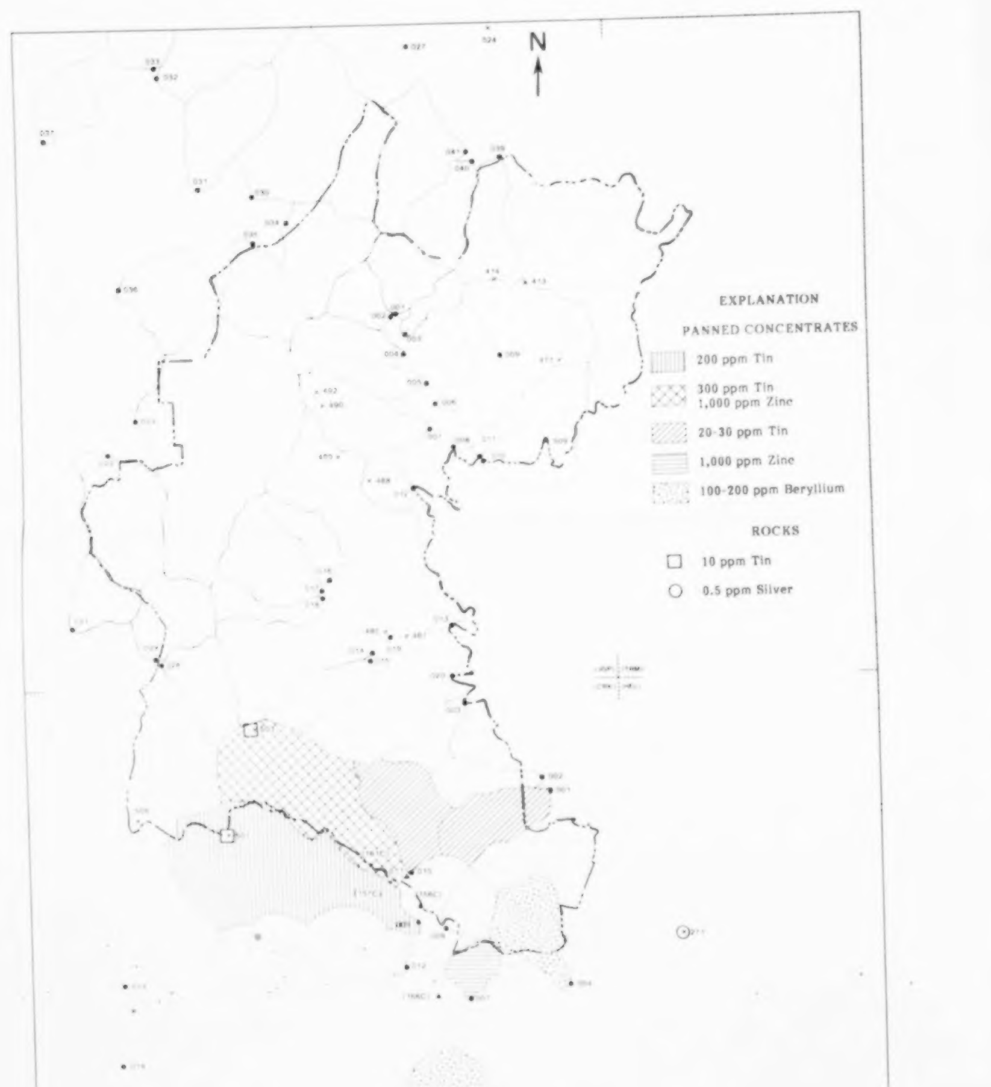
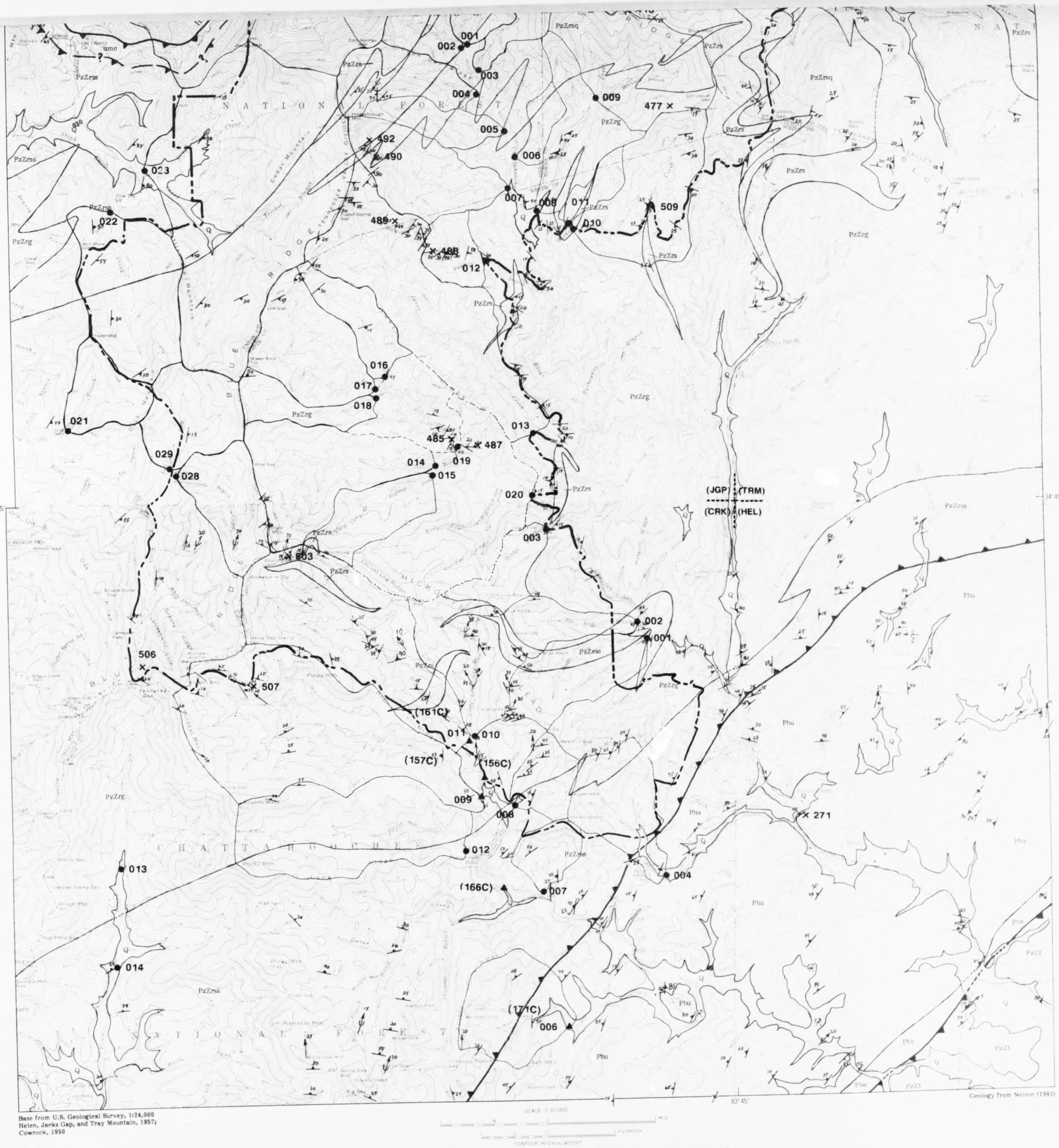


Figure 3.--Map of stream drainage basins with high concentrations of tin, zinc, and beryllium in nonmagnetic fractions of refined panned-concentrate samples of alluvial gravels, and of rocks with anomalous tin or silver. See figure 2 for explanation of other symbols used.



Base from U.S. Geological Survey, 1:24,000
Helen, Jacks Gap, and Tray Mountain, 1957;
Cowrock, 1950

Geology from Nelson (1983)

Figure 2.--Sample location map showing drainage basin outlines for stream-sediment and panned-concentrate samples, and major geologic units

Approximate boundary of roadless area

Contact--Approximately located. Dashed where concealed

Thrust fault--Approximately located. Sawteeth on upper plate. Dashed where concealed; queried where probable

Strike and dip of layering and foliation

Strike and dip of foliation

- Inclined
- Vertical
- Horizontal

Strike and dip of cleavage

Bearing and plunge of lineation

Minor synform showing plunge of axis

Minor antiform showing plunge of axis

Minor fold showing plunge of axis

Abandoned quarry

Abandoned sand and gravel pit

Prospect

Mine

Abandoned mine

004 Outline of drainage basin--Dashed lines indicate greater order drainage basins. Dot indicates U.S. Geological Survey stream-sediment sample location. Triangle and numbers in parentheses indicate resampled basins (see text). Stream-sediment sample number should be prefixed with CRK for samples collected in the Cowrock quadrangle part of the study area, HEL for those in the Helena quadrangle, JGP for those in the Jacks Gap quadrangle, and TRM for those in the Tray Mountain quadrangle. See dashed lines on map indicating quadrangle boundaries.

×467 Rock sample locality

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) to survey certain areas of Federal Lands to determine what mineral resource potential, if any, might be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Chattahoochee Roadless Area. (U.S. Forest Service no. 08-029) in the Chattahoochee National Forest, Union, Towns, and White Counties, Georgia. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979).

INTRODUCTION

The U.S. Geological Survey made a reconnaisance geochemical survey of Chattahoochee Roadless Area (fig. 1) to search for unexposed mineral deposits which might be recognized by a geochemical signature in the abundance or distribution patterns of trace elements. As part of a regional geochemical reconnaissance, M. Hurst (University of Georgia) collected 51 fine-grained stream-sediment samples and 45 panned-concentrate samples of alluvial gravels in the Chattahoochee study area (see figure 1). A.E. Nelson, in conjunction with detailed geologic mapping (Nelson, 1983), collected 10 rock-chip samples for geochemical analysis in addition to a large number of hand specimens for thin-section study. In order to evaluate isolated anomalies indicated by the earlier sampling, R.P. Koeppen, D.M. Sutphin, and P.D. Schruben collected several additional panned-concentrate, stream-sediment, and rock samples from the area in 1986. Both the geologic study by Nelson (1983) and this geochemical survey provide the basis for our mineral-resource assessment of the Chattahoochee Roadless Area (Nelson and others, 1983).

PROCEDURES

Most of the small drainage basins within and immediately adjacent to the study area were sampled by collecting a few handfuls of the finest sediment available and (or) by pan concentrating the heavy minerals in alluvial gravels from the active stream channels. Rock-chip samples representative of the major lithologic units in the area also were collected for geochemical study.

Fine-grained stream sediments were dried and sieved to minus 80-mesh (0.006 in.), then pulverized to minus 140-mesh (0.004 in.). Panned-concentrate samples were washed in bromoform to remove light minerals, then passed by a hand magnet to remove most magnetite. The remaining mineral was then split into magnetic and nonmagnetic fractions on a Frantz isodynamic separator, some at a setting of 1.0 amp, and some at settings of 0.5 and 1.0 amp. The two fractions were crushed and pulverized to minus 140-mesh and analyzed. Rock chips were similarly pulverized.

Each sample was analyzed semiquantitatively for 31 elements by a six-step, direct-current arc, optical-emission spectrographic method (Grimes and Marranzino, 1968) by D.F. Siems at the U.S. Geological Survey laboratories in Denver, Colo. Semiquantitative spectrographic analytical values are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate geometric midpoints of the concentration ranges whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so forth. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time and within two adjoining intervals 96 percent of the time (Motooka and Grimes, 1976). The complete data are reported in Siems and others (1988). Locations of samples and associated drainage basins are shown in figure 2. A statistical study is given in table 1. Partial geochemical data for selected samples discussed in the text is given in table 2.

DISCUSSION

Our reconnaissance geochemical survey of the Chattahoochee Roadless Area found trace-metal enrichment in panned concentrates and one rock sample. In this survey, no metallic mineral deposits were found. However, slightly enriched trace-metal levels were identified in a number of samples. Geochemical data for six elements (iron, manganese, silver, tin, zinc, and beryllium) show a few high concentrations in either stream-sediment or rock samples. Although the study area is located immediately adjacent to the Dahlonega gold belt, none of our geochemical samples contained detectable amounts of gold. The few anomalous metal concentrations found do not indicate the presence of mineral deposits. The sources of local concentrations of trace elements is not known. The geochemical data for the trace-element enriched samples are discussed individually in the following section.

Geologic Setting

Metamorphic rocks of three major lithotectonic units form part of Blue Ridge Mountains in the southern Appalachians. They are the Great Smoky thrust sheet, the Richard Russell thrust sheet, and the Helen thrust sheet (Nelson, 1983; Nelson and Gillon, 1985; Nelson and others, 1987). Almost all of the exposed rocks in the Chattahoochee Roadless Area are part of the Richard Russell thrust sheet with the exception of a relatively narrow band of mafic and ultramafic rocks that occurs along the northwest boundary of the study area. The Richard Russell thrust sheet in the study area is underlain immediately to the northwest by rocks of the Great Smoky thrust sheet and on the southeast by rocks of the Helen thrust sheet. The Richard Russell and Great Smoky thrust sheets are separated by the southeast-dipping Hayesville fault (Hatcher and Williams, 1978; Nelson and Gillon, 1985).

Richard Russell thrust sheet.--Most of the Chattahoochee Roadless Area is underlain by rocks of the Richard Russell Formation (Nelson and Gillon, 1985, p. A61). This rock assemblage includes polydeformed, highly migmatitic biotite gneiss, biotite schist, fine-grained biotite-feldspar gneiss, metasandstone, amphibolite, hornblende gneiss, granite gneiss, discontinuous pegmatite veins and pods of varying size, and many irregular granitic masses. Sillimanite, though widely distributed, generally occurs in rocks with a low muscovite content.

Helen thrust sheet.--Although rocks of the Helen thrust sheet do not occur at the surface within the Chattahoochee Roadless Area, they are exposed less than 330 ft from the southeast border of the study area. Rocks in the thrust sheet include metagraywacke, quartzite, graphite-bearing garnet-muscovite-biotite schist, biotite-feldspar metasandstone, and pegmatite veins and pods. The metasandstone is locally conglomeratic and interlayered with thin beds of muscovite schist. Thin to thick layers of amphibolite also are present.

Table 1.--*Statistical summary of geochemical data for the Chattahoochee Roadless Area, from data in Siems and others (1988). Data from other wilderness areas shown for comparison*

All analyses in U.S. Geological Survey laboratories, Denver, Colo., by D.F. Siems using semiquantitative spectrographic methods, except for zinc in panned concentrate M1 (1.0 amp magnetic) fraction which was determined by atomic absorption methods by D.F. Siems. Spectrographic analyses are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate medians of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. The precision is expected to be within one adjoining reporting interval on each side of the reported value 83 percent of the time; M1, 1.0 amp magnetic fraction. Symbols used: >, amount is greater than number shown; <, amount is less than number shown; --, not detected.

	STREAM SEDIMENTS										PANNED CONCENTRATES								ROCKS (GNEISS)								
	CHATTAHOOCHEE			AR[1]	BM[7]	SN[8]	CM[2]	ER[3]	SR[5]	TM[4]	CHATTAHOOCHEE			SN[8]	AR[1]	CM[2]	ER[3]	TM[4]	CHATTAHOOCHEE			BM[7]	CM[2]	SN[8]	ER[3]	SR[5]	Average[6,9] sandstone
	n=51			n=19	n=57	n=171	n=30	n=103	n=94	n=87	n=41			n=139	n=12	n=10	n=76	n=78	n=10			n=15	n=16	n=148	n=10	n=37	
Element	Low	High	Median	Median	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	
	PERCENT																										
Calcium	0.05	0.5	0.15	0.3	0.3	0.5	0.6	0.3	1	0.3	0.1	1.5	0.15	0.2	0.3	0.07	0.5	0.2	0.15	2	0.3	1	0.7	0.5	1	1	3.9
Iron	2	7	3.	2	2	5	5	2	7	2.5	.1	20	.7	.7	.5	2	15	.3	1	7	5	10	2.5	3	5	5	.98
Magnesium	.1	1.5	.5	.5	1	.7	.5	.3	1	.3	.05	2	.1	.07	.2	.5	.15	.1	.3	1.5	1	1	.7	1	1	1	.7
Titanium	.2	1	.5	.5	1	1	.7	.3	.5	.4	.7	2	1.5	2	1.4	>1	>1	1.2	.03	2.0	.3	.5	.5	.5	.5	.5	.15
	PARTS PER MILLION (ppm)																										
Barium	150	2,000	700	500	1,000	300	500	500	700	330	<50	300	70	50	300	125	100	90	500	1,500	1,000	700	500	500	700	1,000	300
Beryllium	<1	2	1	2	1.5	1	1.5	<1	1.5	1	<2	200	<2	<2	<2	<1	<1	--	1	7	2	2	1	1	1	1	2
Boron	<10	200	10	<10	<10	<10	10	10	15	10	<20	150	<5	20	20	20	20	--	<10	10	<10	<10	<10	10	<10	10	35
Chromium	20	70	50	70	100	70	50	20	100	50	<20	300	70	100	50	200	100	80	10	1,500	100	100	30	30	60	50	35
Cobalt	7	30	15	10	20	10	20	7	15	15	<10	20	<10	<10	<10	7	15	20	<5	15	10	10	10	10	7	10	.3
Copper	<5	50	20	20	50	15	20	7	20	20	--	--	--	<10	<10	7	<5	20	7	100	30	30	10	10	10	15	10-20
Lanthanum	20	500	150	100	300	50	150	30	100	50	<50	2,000	50	100	200	400	500	130	<20	200	150	50	30	50	50	50	7
Lead	<10	70	20	30	20	15	30	20	50	15	<20	150	20	<20	<20	<10	<10	45	20	70	30	20	13	15	40	20	7
Manganese	200	1,000	500	700	700	1,000	2,000	300	1,500	550	<50	10,000	150	100	100	300	5,000	80	30	700	500	500	700	700	500	700	500
Molybdenum	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	--	--	<10	<10	<10	<10	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	.2
Nickel	5	30	20	15	15	20	20	10	20	30	<10	50	10	<10	<10	10	<5	30	7	30	10	30	15	15	10	20	2
Niobium	<20	30	<20	<20	15	<20	<20	<20	<20	20	<50	700	100	<50	<50	25	50	70	<20	--	<20	<20	<20	<20	<20	<20	.0X[10]
Scandium	5	20	15	7	20	7	15	7	15	10	<20	200	70	<10	<10	5	30	30	<5	20	15	15	10	10	10	10	1
Strontium	<100	150	<100	<100	<100	100	200	<100	150	100	<200	300	<200	<200	200	<200	<100	--	<100	300	200	100	100	200	150	200	20
Thorium	<100	--	<100	<100	--	<100	--	<100	<100	--	--	--	<200	<200	<200	--	<100	--	<10	--	<10	<10	<10	<10	<10	<10	.X[10]
Tin	<10	--	<10	<10	<10	<10	<10	<10	<10	<10	<20	300	<20	<20	<20	<20	<10	--	<100	--	<100	<100	--	--	<100	<100	5.5
Vanadium	30	150	100	50	100	100	100	50	100	70	50	500	200	70	100	200	150	90	10	150	100	100	70	<100	85	100	20
Yttrium	15	150	70	70	100	50	70	30	50	30	70	2,000	700	100	500	50	700	600	<10	70	50	70	30	50	20	30	10
Zinc	<200	--	<200	<200	<200	<200	<200	<200	<200	260	<500	1,000	<500	<500	<500	<200	<200	650	<200	200	<200	<200	<200	30	<200	<200	16
Zirconium	100	>1,000	700	700	1,000	500	300	500	300	400	2,000	<2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000	<10	500	100	700	200	200	300	[illegible]	220

[1] AR--Anna Ruby Roadless Area (Lesure and others, 1987)
[2] CM--Craggy Mountain Wilderness Study Area (Lesure and others, 1982, p. 13-16)
[3] ER--Ellicott Rock Wilderness (Luce and others, 1985)
[4] TM--Tray Mountain Roadless Area (Koeppen and Nelson, 1988)
[5] SR--Shining Rock Wilderness (Lesure, 1981)
[6] Turekian (1977, p. 629)
[7] BM--Blood Mountain Roadless Area (Koeppen and Nelson, in press)
[8] SN--Southern Nantahala Wilderness (Peper and others, in press)
[9] Pettijohn (1963, p. S11)
[10] Order of magnitude (Turekian, 1977, p. 629)

Table 2.--*Partial analyses from the Chattahoochee Roadless Area. Tin, zinc, beryllium, and silver are spectrophotometrically determined. Analysis by D.E. Detra.*

SAMPLE NO.	TIN	ZINC	BERYLLLIUM	SILVER
		PANNED CONCENTRATES		
GCO2156C	70	500	L(2)	N(1)
GCO2157C	700	N(500)	L(2)	N(1)
GCO2161C	70	700	L(2)	N(1)
GCO2166C	100	L(500)	L(2)	N(1)
GCO2171C	0	L(500)	10	N(1)
CRK004C	0	N(200)	100	N(.5)
CRK006C	0	N(200)	200	N(.5)
CRK009C	200	1,000	3	N(.5)
CRK011C	300	0	3	N(.5)
		ROCKS		
N492R	N(10)	200	2	.5
N503R	10	200	1	N(.5)
N271R	N(10)	N(200)	7	.5

GEOCHEMICAL SURVEY OF THE CHATTAHOOCHEE ROADLESS AREA, TOWNS, UNION, AND WHITE C

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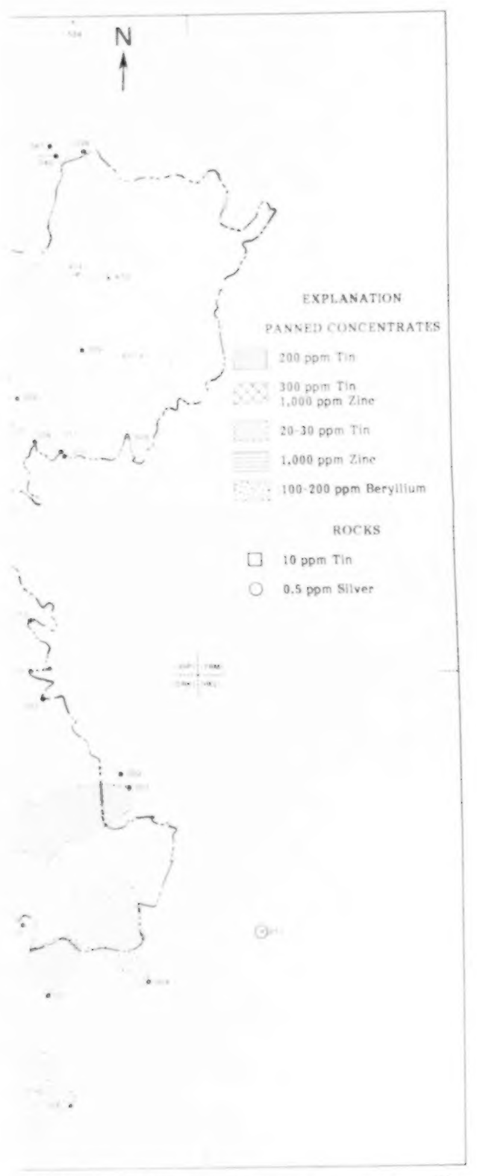
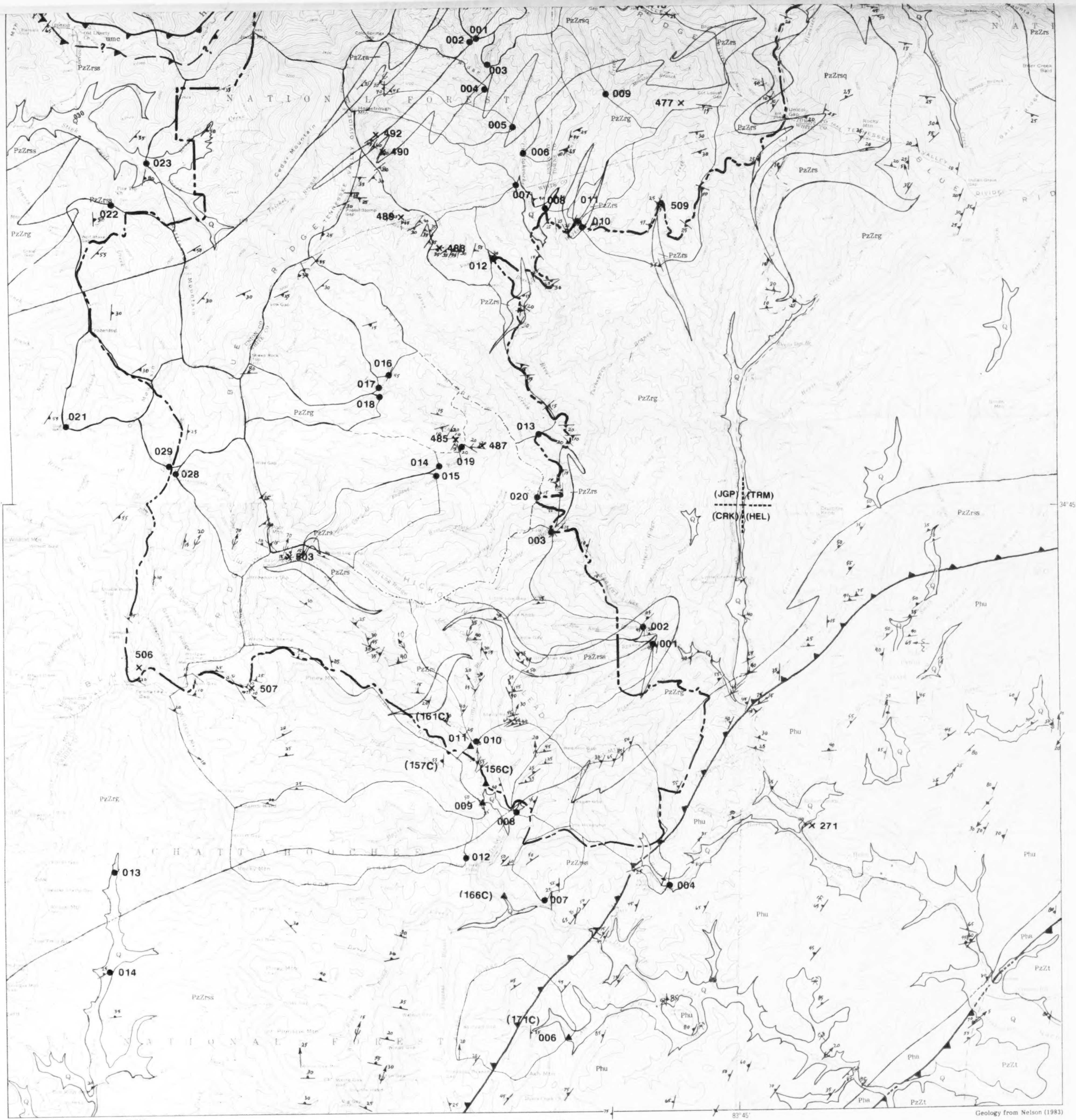
less Areas

13 Long Creek (08-113)
14 Worley Ridge (08-224)
15 Tray Mountain (08-)
16 Anna Ruby (08-225)
17 Chattahoochee (08-029)
18 Raven Cliff (A8028)
19 Raven Cliff (B8028)
20 Blood Mountain (08-027)
21 Board Camp (08-145)

ilderness and roadless areas and major structural d adjacent North and South Carolina. The ern. Number after roadless name is U.S. Forest y modified from Hatcher and Butler (1979) and



high concentrations of tin, zinc, and beryllium in concentrate samples of alluvial gravels, and of gure 2 for explanation of other symbols used.



Base from U.S. Geological Survey, 1:24,000
Helen, Jacks Gap, and Tray Mountain, 1957;
Cowrock, 1950

Geology from Nelson (1983)

Figure 2.--Sample location map showing drainage basin outlines for stream-sediment and panned-concentrate samples, and major geologic units

Approximate boundary of roadless area

Contact--Approximately located. Dashed where concealed

Thrust fault--Approximately located. Sawteeth on upper plate. Dashed where concealed; queried where probable

Strike and dip of layering and foliation

Strike and dip of foliation

- Inclined
- Vertical
- Horizontal

Strike and dip of cleavage

Bearing and plunge of lineation

Minor synform showing plunge of axis

Minor antiform showing plunge of axis

Minor fold showing plunge of axis

Abandoned quarry

Abandoned sand and gravel pit

Prospect

Mine

Abandoned mine

004 Outline of drainage basin--Dashed lines indicate greater order drainage basins. Dot indicates U.S. Geological Survey stream-sediment sample location. Triangle and numbers in parentheses indicate resampled basins (see text). Stream-sediment sample number should be prefixed with CRK for samples collected in the Cowrock quadrangle part of the study area, HEL for those in the Helena quadrangle, JGP for those in the Jacks Gap quadrangle, and TRM for those in the Tray Mountain quadrangle. See dashed lines on map indicating quadrangle boundaries.

×467 Rock sample locality

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey (USGS) and U.S. Bureau of Mines (USBM) to survey certain areas of Federal Lands to determine what mineral resource potential, if any, might be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Chattahoochee Roadless Area. (U.S. Forest Service no. 08-029) in the Chattahoochee National Forest, Union, Towns, and White Counties, Georgia. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979).

INTRODUCTION

The U.S. Geological Survey made a reconnaisance geochemical survey of Chattahoochee Roadless Area (fig. 1) to search for unexposed mineral deposits which might be recognized by a geochemical signature in the abundance or distribution patterns of trace elements. As part of a regional geochemical reconnaissance, M. Hurst (University of Georgia) collected 51 fine-grained stream-sediment samples and 45 panned-concentrate samples of alluvial gravels in the Chattahoochee study area (see figure 1). A.E. Nelson, in conjunction with detailed geologic mapping (Nelson, 1983), collected 10 rock-chip samples for geochemical analysis in addition to a large number of hand specimens for thin-section study. In order to evaluate isolated anomalies indicated by the earlier sampling, R.P. Koeppen, D.M. Sutphin, and P.D. Schruben collected several additional panned-concentrate, stream-sediment, and rock samples from the area in 1986. Both the geologic study by Nelson (1983) and this geochemical survey provide the basis for our mineral-resource assessment of the Chattahoochee Roadless Area (Nelson and others, 1983).

PROCEDURES

Most of the small drainage basins within and immediately adjacent to the study area were sampled by collecting a few handfuls of the finest sediment available and (or) by pan concentrating the heavy minerals in alluvial gravels from the active stream channels. Rock-chip samples representative of the major lithologic units in the area also were collected for geochemical study.

Fine-grained stream sediments were dried and sieved to minus 80-mesh (0.006 in.), then pulverized to minus 140-mesh (0.004 in.). Panned-concentrate samples were washed in bromoform to remove light minerals, then passed by a hand magnet to remove most magnetite. The remaining mineral was then split into magnetic and normagnetic fractions on a Frantz isodynamic separator, some at a setting of 1.0 amp, and some at settings of 0.5 and 1.0 amp. The two fractions were crushed and pulverized to minus 140-mesh and analyzed. Rock chips were similarly pulverized.

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DISCUSSION

Our reconnaissance geochemical survey of the Chattahoochee Roadless Area found trace-metal enrichment in panned concentrates and one rock sample. In this survey, no metallic mineral deposits were found. However, slightly enriched trace-metal levels were identified in a number of samples. Geochemical data for six elements (iron, manganese, silver, tin, zinc, and beryllium) show a few high concentrations in either stream-sediment or rock samples. Although the study area is located immediately adjacent to the Dahlonega gold belt, none of our geochemical samples contained detectable amounts of gold. The few anomalous metal concentrations found do not indicate the presence of mineral deposits. The sources of local concentrations of trace elements is not known. The geochemical data for the trace-element-enriched samples are discussed individually in the following section.

Geologic Setting

Metamorphic rocks of three major lithotectonic units form part of Blue Ridge Mountains in the southern Appalachians. They are the Great Smoky thrust sheet, the Richard Russell thrust sheet, and the Helen thrust sheet (Nelson, 1983; Nelson and Gillon, 1985; Nelson and others, 1987). Almost all of the exposed rocks in the Chattahoochee Roadless Area are part of the Richard Russell thrust sheet with the exception of a relatively narrow band of mafic and ultramafic rocks that occurs along the northwest boundary of the study area. The Richard Russell thrust sheet in the study area is underlain immediately to the northwest by rocks of the Great Smoky thrust sheet and on the southeast by rocks of the Helen thrust sheet. The Richard Russell and Great Smoky thrust sheets are separated by the southeast-dipping Hayesville fault (Hatcher and Williams, 1978; Nelson and Gillon, 1985).

Richard Russell thrust sheet.--Most of the Chattahoochee Roadless Area is underlain by rocks of the Richard Russell Formation (Nelson and Gillon, 1985, p. A61). This rock assemblage includes polydeformed, highly migmatitic biotite gneiss, biotite schist, fine-grained biotite-feldspar gneiss, metasandstone, amphibolite, hornblende gneiss, granite gneiss, discontinuous pegmatite veins and pods of varying size, and many irregular granitic masses. Sillimanite, though widely distributed, generally occurs in rocks with a low muscovite content.

Helen thrust sheet.--Although rocks of the Helen thrust sheet do not occur at the surface within the Chattahoochee Roadless Area, they are exposed less than 330 ft from the southeast border of the study area. Rocks in the thrust sheet include metagraywacke, quartzite, graphite-bearing garnet-muscovite-biotite schist, biotite-feldspar metasandstone, and pegmatite veins and pods. The metasandstone is locally conglomeratic and interlayered with thin beds of muscovite schist. Thin to thick layers of amphibolite also are present.

Tin and zinc

Tin was detected in both heavy-mineral panned-concentrate and rock samples from the area. Panned concentrate samples (CRK009 and CRK011, table 2 and figure 3) from drainage basins along the southern border of the roadless area contain 300 and 200 ppm of tin, respectively; sample CRK009 also contains 1,000 ppm of zinc. Samples from several other nearby streams contained lower values for tin and higher values for zinc. These were the elements that showed the most well-defined distribution within the roadless area. Some samples also showed slight enrichments of lead (50-150 ppm). Resampling from these streams in 1985 also identified anomalous levels of tin (70-700 ppm) and zinc (500-1,000 ppm) (table 2 and figure 3). The tin occurs in the nonmagnetic fraction of the panned-concentrate samples, thus suggesting that the occurrence is in the form of cassiterite and not as a solid-solution component of magnetite. Only one rock sample (N503), a mica schist, contains detectable amounts of tin (10 ppm). This single tin-bearing rock sample came from the same catchment from which tin-enriched panned-concentrate samples were retrieved. The high tin content identified in the initial sampling was reproduced during resampling. This suggests that the high values probably were not a result of any analytical bias; the tin levels for all other samples from the roadless area were below the limit of determination. The clustering of tin values in the southern part of the roadless area may reflect a possible stratigraphic or structural control. Tin occurs sporadically in stream sediments derived from the Richard Russell Formation rocks (Koeppen and Nelson, 1988; Siems and others, 1988), but a source of these scattered anomalies is not known. Anomalous generally low tin values (15-30 ppm) have been identified elsewhere in the Richard Russell Formation in calc-silicate lenses (Peper and others, in press). Visible evidence of any tin mineralization in the area is not present. Therefore, these anomalous values for tin in the Chattahoochee Roadless Area are unlikely to be indicators of significant economic mineralization.

Beryllium

Panned-concentrate samples from Ash Creek (CRK004) and Horton Creek (CRK006) (fig. 3) at the southeast edge of the roadless area contain 100 and 200 ppm beryllium, respectively. Both streams were resampled, but only the sample from Ash Creek (GCO217C) produced an anomalous beryllium concentration of 10 ppm. Sheared granite and granite pegmatite occur within these stream drainages, but samples of these rocks, and all other rock samples from the study area, contained no significant beryllium (1-3 ppm). The Helen pegmatite district, located approximately 10 km to the northeast, was identified by W.R. Griffitts (1960, written commun.) as a beryllium prospective area, but we have been unable to find reports of either gemstone beryl occurrences or beryl production from this district. The absence of identified beryllium enrichment in other samples from the area indicates that the beryllium in these three panned-concentrate samples is anomalous. Although beryl mineralization is commonly associated with pegmatites, the abundant pegmatite pods and dikes in this area yielded no beryl occurrences. The source of the beryllium is not known. The available data indicate that there is little or no potential for beryllium resources in the Chattahoochee Roadless Area.

CONCLUSIONS

A few heavy-mineral panned-concentrate and several rock samples contained low, though anomalous, concentrations of certain trace metals. Anomalous concentrations of trace metals were identified in panned-concentrate samples from streams clustered near one another near the southwest corner of the area: one contains 300-700 ppm tin, three others contain 70-100 ppm tin, and several contain 500-1,000 ppm zinc. The rock samples yielded anomalous tin and silver. A mica schist sample from the same catchment where an anomalous tin-enriched panned-concentrate sample also was collected contains 10 ppm tin. A metasandstone sample contained a low concentration of silver. Several stream-sediment samples from along or near the southern boundary of the area contain low to moderate levels of beryllium; resampling confirmed the presence of beryllium although at much lower intensity than the original sampling. These anomalous metal concentrations could be related to low-grade mineralizing processes; if so, it seems unlikely that the results of these processes would be deposits of significant size or of economic importance. Further investigation involving a more thorough and detailed geochemical sampling design would be required to corroborate and determine the significance of the anomalous trace-element concentrations reported here. The available geochemical data indicate that these dispersed geochemical anomalies represent only isolated minor mineral occurrences and that there is little, if any, potential for significant metallic mineral resources in the Chattahoochee Roadless Area.

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Table 1.--*Statistical summary of geochemical data for the Chattahoochee Roadless Area, from data in Siems and others (1988). Data from other wilderness areas shown for comparison*

All analyses in U.S. Geological Survey laboratories, Denver, Colo., by D.F. Siems using semiquantitative spectrographic methods, except for zinc in panned-concentrate M1 (1.0 amp magnetic) fraction which was determined by atomic absorption methods by D.F. Siems. Spectrographic analyses are reported as six steps per order of magnitude (1.0, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers) and are approximate medians of geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc. The precision is expected to be within one adjoining reporting interval on each side of the reported value 83 percent of the time; M1, 1.0 amp magnetic fraction. Symbols used: >, amount is greater than number shown; <, amount is less than number shown; --, not detected.

SEDIMENTS					PANNED CONCENTRATES								ROCKS (GNEISS)								
SN[8]	CM[2]	ER[3]	SR[5]	TM[4]	CHATTAHOOCHEE			SN[8]	AR[1]	CM[2]	ER[3]	TM[4]	CHATTAHOOCHEE			BM[7]	CM[2]	SN[8]	ER[3]	SR[5]	Average[6,9] sandstone
n=171	n=30	n=103	n=94	n=87	n=41			n=139	n=12	n=10	n=76	n=78	n=10			n=15	n=16	n=148	n=10	n=37	
Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	Low	High	Median	Median	Median	Median	Median	Median	
PERCENT																					
0.5	0.6	0.3	1	0.3	0.1	1.5	0.15	0.2	0.3	0.07	0.5	0.2	0.15	2	0.3	1	0.7	0.5	1	1	3.9
5	5	2	7	2.5	.1	20	.7	.7	.5	2	15	.3	1	7	5	10	2.5	3	5	5	.98
.7	.5	.3	1	.3	.05	2	.1	.07	.2	.5	.15	.1	.3	1.5	1	1	.7	1	1	1	.7
1	.7	.3	.5	.4	.7	2	1.5	2	1.4	>1	>1	1.2	.03	2.0	.3	.5	.5	.5	.5	.5	.15
PARTS PER MILLION (ppm)																					
300	500	500	700	330	<50	300	70	50	300	125	100	90	500	1,500	1,000	700	500	500	700	1,000	300
1	1.5	<1	1.5	1	<2	200	<2	<2	<2	<1	<1	--	1	7	2	2	1	1	1	1	2
<10	10	10	15	10	<20	150	<5	20	20	20	20	--	<10	10	<10	<10	<10	10	<10	10	35
70	50	20	100	50	<20	300	70	100	50	200	100	80	10	1,500	100	100	30	30	60	50	35
10	20	7	15	15	<10	20	<10	<10	<10	7	15	20	<5	15	10	10	10	10	7	10	.3
15	20	7	20	20	--	--	--	<10	<10	7	<5	20	7	100	30	30	10	10	10	15	10-20
50	150	30	100	50	<50	2,000	50	100	200	400	500	130	<20	200	150	50	30	50	50	50	7
15	30	20	50	15	<20	150	20	<20	<20	<10	<10	45	20	70	30	20	13	15	40	20	7
1,000	2,000	300	1,500	550	<50	10,000	150	100	100	300	5,000	80	30	700	500	500	700	700	500	700	500
<5	<5	<5	<5	<5	--	--	<10	<10	<10	<10	<5	--	<5	<5	<5	<5	<5	<5	<5	<5	.2
20	20	10	20	30	<10	50	10	<10	<10	10	<5	30	7	30	10	30	15	15	10	20	2
<20	<20	<20	<20	20	<50	700	100	<50	<50	25	50	70	<20	--	<20	<20	<20	<20	<20	<20	.0X[10]
7	15	7	15	10	<20	200	70	<10	<10	5	30	30	<5	20	15	15	10	10	10	10	1
100	200	<100	150	100	<200	300	<200	<200	200	<200	<100	--	<100	300	200	100	180	200	150	200	20
<100	--	<100	<100	--	--	--	<200	<200	<200	--	<100	--	<10	--	<10	<10	<10	<10	<10	<10	.X[10]
<10	<10	<10	<10	<10	<20	300	<20	<20	<20	<20	<10	--	<100	--	<100	<100	--	--	<100	<100	5.5
100	100	50	100	70	50	500	200	70	100	200	150	90	10	150	100	100	70	<100	85	100	20
50	70	30	50	30	70	2,000	700	100	500	50	700	600	<10	70	50	70	30	50	20	30	10
<200	<200	<200	<200	260	<500	1,000	<500	<500	<500	<200	<200	650	<200	200	<200	<200	<200	30	<200	<200	16
500	300	500	300	400	2,000	<2,000	>2,000	>2,000	>2,000	600	>1,000	>2,000	<10	500	100	700	200	200	300	200	220

others, 1982, p. 13-16)

1988)

in press)

press)

Table 2.--*Partial analyses from the Chattahoochee Roadless Area. Tin, zinc, beryllium, and silver are spectrophotometrically determined. Analysis by D.E. Detra.*

SAMPLE NO.	TIN	ZINC	BERYLLLIUM	SILVER
PANNED CONCENTRATES				
GCO2156C	70	500	L(2)	N(1)
GCO2157C	700	N(500)	L(2)	N(1)
GCO2161C	70	700	L(2)	N(1)
GCO2166C	100	L(500)	L(2)	N(1)
GCO2171C	0	L(500)	10	N(1)
CRK004C	0	N(200)	100	N(.5)
CRK006C	0	N(200)	200	N(.5)
CRK009C	200	1,000	3	N(.5)
CRK011C	300	0	3	N(.5)
ROCKS				
N492R	N(10)	200	2	.5
N503R	10	200	1	N(.5)
N271R	N(10)	N(200)	7	.5

MAP MF-1502-B

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOCHEMICAL SURVEY OF THE CHATTAHOOCHEE ROADLESS AREA, TOWNS, UNION, AND WHITE COUNTIES, GEORGIA

By Robert P. Koeppen and Arthur E. Nelson

MISCELLANEOUS FIELD STUDIES MAP
Published by the U.S. Geological Survey, 1989

KOEPPEN AND NELSON—GEOCHEMICAL SURVEY, CHATTAHOOCHEE ROADLESS AREA, GA 1:30,000 MAP MF-1502-B